A NEW SEMI-SLUG FROM TAMBORINE MOUNTAIN, SOUTHEASTERN QUEENSLAND (MOLLUSCA: EUPULMONATA: HELICARIONIDAE)

JOHN STANISIC

Stanisic, J. 1998 06 29: A new semi-slug from Tamborine Mountain, southeastern Queensland (Mollusca: Eupulmonata: Helicarionidae). *Memoirs of the Queensland Museum* **42**(2): 597-603. Brisbane. ISSN 0079-8835.

The helicarionid semi-slug, *Cucullarion parkini* gen. et sp. nov., is described from the rainforests of Tamborine Mountain, southeastern Queensland. Its relationships and isolation in these upland refugia are discussed in relation to climate-induced shifts in the distribution of wet rainforest in eastern Australia since the mid- to late Tertiary. □ *Mollusca, Eupulmonata, Helicarionidae, semi-slug, biogeography.*

John Stanisic, Queensland Museum, PO Box 3300, South Brisbane 4101, Australia; *10 July 1997.*

Helicarionid semi-slugs have diversified greatly in the humid rainforests of eastern Australia. These perennially moist environments are ideally suited to terrestrial molluscs which have a weakly to non-calcified, reduced shell into which the animal cannot fully withdraw. A comprehensive review of the group has yet to be completed and there are still many species to be described from the eastern Australian region. However, Kershaw (1979, 1981, 1983) and Stanisic (1993a, b) have advanced our knowledge of this group considerably. Several species are known from southeastern Queensland (SEQ) (Smith, 1992; Stanisic, 1995) but the taxonomic status of the majority of these has yet to be rigourously tested by detailed anatomical examination. This study describes a new species of semi-slug from Tamborine Mtn, SEQ which is characterised by extreme reduction of the shell and strong development of the shell lappets and mantle lobes.

STUDY AREA

Tamborine Mtn is located c. 80km SW of Brisbane (Fig. 5) and is part of a large basaltic plateau (Darlington Ra.) which is a northward extension of the MacPherson Ranges (MacDonald, 1988). Average annual rainfall is 1600mm and year-round humidity is high (MacDonald, 1988). Volcanically derived soils (red earths) support moist subtropical rainforest (as complex notophyll vine forests) on the mountain summit. At lower altitudes these evergreen rainforests (with large stands of the palm *Archontophoenix cunninghamiana*) are also able to survive in moist refuges such as gullies and along watercourses (Webb, 1988). Aboriginal man, and more recently Europeans, have greatly influenced contemporary vegetation patterns (Webb, 1988). Much of the mountain was cleared in the early part of this century (Ross, 1988) and it is probably fortuitous that remnant patches of rainforest survive at all. Many of these remnants are in fire-proof niches such as the less accessible steeply sided gorges which occur on the mountain's extensive slopes.

SYSTEMATICS

The classification used in this study follows Smith (1992) unless otherwise stated. Anatomical abbreviations follow Solem (1966, 1976) and are explained in the text.

Order EUPULMONATA
Sub-order STYLOMMATOPHORA
Family HELICARIONIDAE

Cucullarion gen. nov.

ETYMOLOGY. Latin *cucullus*, cowl; referring to the hood-like appearance of the mantle lobes.

TYPE SPECIES. *Cucullarion parkini* sp. nov.

DIAGNOSIS. Shell degenerate, almost plate-like with incomplete internal whorls. Whorls relatively few with obsolete sculpture. Animal with strongly developed shell lappets and mantle lobes, long slender foot, dorsally keeled tail and prominent caudal horn. Genitalia with epiphallic flagellum but no epiphallic caecum. Penis internally with sculptured longitudinal pilasters, weak pustules and a subcylindrical verge with subterminal epiphallic pore.

COMPARISONS. *Cucullarion* gen. nov. differs most notably from the northeastern Queensland (NEQ) *Fastosarion* Iredale, 1933 by having a much smaller shell with incomplete internal whorls and in the male genitalia lacking an epiphallic caecum and having a penis with a verge (Scott,1995). *Thularion* Stanisic, 1993 from NEQ

has a shell with incomplete internal whorls but which is much larger and strongly spirally sculptured. An epiphallic caecum is present and the penis is greatly elongated with pustulose sculpture internally, a prominent lamellate pilaster in the upper half and no penial verge. *Eungarion* Stanisic, 1993 from mideastern Queensland (MEQ) has a shell which is much smaller than that of *Cucullarion* but which is similarly reduced and lacking in spiral sculpture. An epiphallic caecum is present and the penis has internal sculpture of strongly rounded pustules, two prominent pustulose pilasters and an apical verge which opens terminally. *Parmacochlea* Smith, 1884 from far N Queensland has a small, flat plate-like shell without membranous margins, penis with strongly nodulose pustules internally and a verge with a terminal pore.

Helicarion sensu stricto from SE Australia has a shell with complete internal whorls. It lacks an epiphallic caecum, however more significantly, it possesses an epiphallic gland (Kershaw, 1981). This structure has yet to be recorded in any 'northern' semi-slug genera (Hedley, 1893; Scott, 1995; Stanisic, 1993a,b) and probably reflects a major phyletic division within the eastern Australian semi-slugs. These accessory epiphallic structures are probably concerned with spermatophore formation and most likely determine the shape of the sperm packet. Stanisic (1993b) has previously suggested that there are major differences in the form of spermatophores between southern and northern east-coast helicarionids which may transcend the level of species isolating mechanisms and indicate broader evolutionary relationships. Unfortunately the material studied did not contain spermatophores.

Cucullarion parkini sp. nov.
(Figs 1-4)

ETYMOLOGY. For Roger Parkin who purchased the naming rights of the species at the Queensland Museum's tenth anniversary celebratory dinner.

MATERIAL. HOLOTYPE: QMMO60128, shell and preserved animal, The Knoll NP, Tamborine Mtn, SEQ, notophyll vine forest/palms, climbing palm trees after rain. Coll. J. Stanisic, D. & N. Potter, J. Chaseling, 26 Feb 1985. Major diameter of shell 14.94mm, minor diameter 9.09mm, height 3.25mm, H/D ratio 1.64, whorls 2 3/8; length of preserved animal 37.22mm. PARATYPES: QMMO20858, 9 preserved animals, 1 shell, same data as holotype; MO27502, 1 shell, Tamborine Mtn, SEQ, Colliver Collection.

DESCRIPTION. Shell (Fig. 1) of average size for family, glossy, lenticular, very thin, fragile and almost plate-like, maximum diameter 14.94-15.58mm (mean 15.26mm), minimum diameter 9.09-9.35mm (mean 9.22mm). Spire not elevated. Height of shell 1.95-3.25mm (mean 2.60mm), H/D ratio 1.64-1.67 (mean 1.66). Whorls 2 3/8-2 7/8 (mean 2 5/8), expanding rapidly, without internal walls. Body whorl expansive, weakly rounded toward the edges, margins membranous. Protoconch of 1 1/4 whorls, smooth. Post-nuclear sculpture of weak arcuate growth lines. Sutures margined, barely impressed. Colour yellow with few arcuate darker streaks; apex white. Based on 2 measured specimens (QMMO60128, MO27502).

FIG. 1. Shell of *Cucullarion parkini* sp. nov., holotype, QMMO60128. Upper, apical view. Lower, basal view. Scale in mm.

Animal (Fig. 2) comparatively large, body length (in preservative) to 47.70mm (mean 44.74mm, n=3). Foot slender, tripartite, rounded anteriorly, weakly tapered posteriorly; tail relatively long, high, sharply keeled mid-dorsally; caudal horn and foss very prominent. Pedal grooves conspicuous, situated relatively low down on the sides of the foot. Colour (in life) beige with diffuse grey markings on visceral hump and sides of tail; antero-dorsal region of tail and edges of foot with light yellow markings; slime reticulation yellow on the tail, grey on neck and anterior sides of the foot; sole of foot off-white. Skin texture (in 70% ethanol) smooth; (in life) mainly smooth but with microscopic pustules on shell lappets and mantle lobes (Fig. 2C). Right mantle lobe (RML) small, narrowly elon-

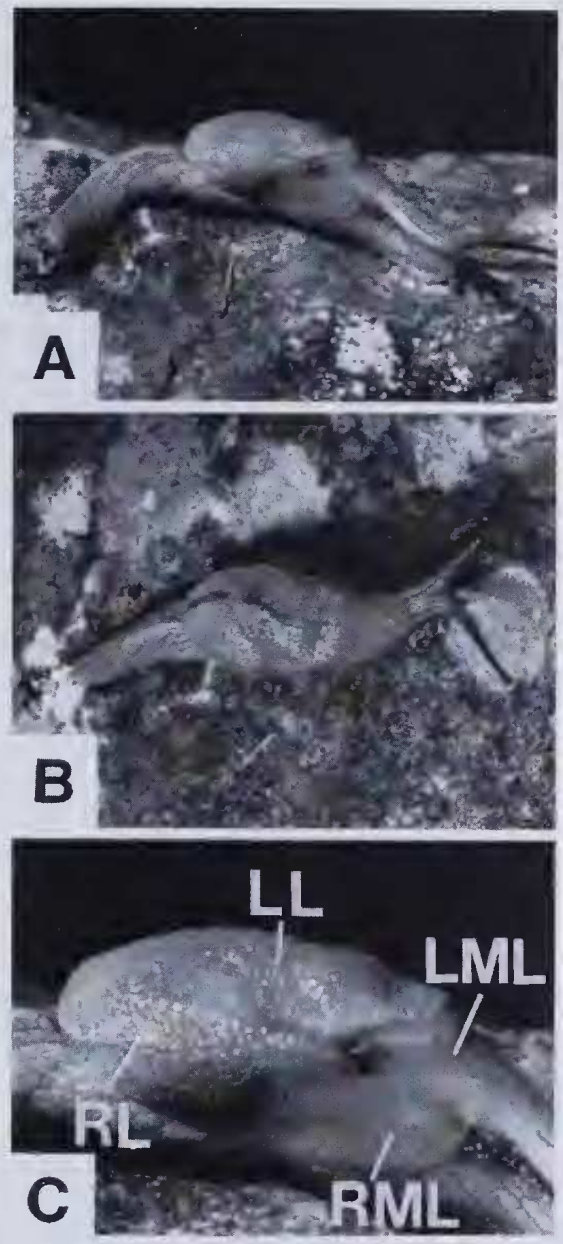

FIG. 2. Live animal of *Cucullarion parkini* sp. nov., holotype, QMMO60128. A, side view. B, top view. C, close-up of visceral hump to show shell lappets and mantle lobes with minute pustulations.

gate, fused to right shell lappet (RL) posteriorly and with a short lobular extension anteriorly. Left mantle lobe (LML) a cowl-like extension over the neck region, fused to the left shell lappet posteriorly; shell lappets fused to each other both anteriorly and posteriorly. Shell barely visible (Fig. 2B).

Genitalia (Fig. 3A) with ovotestis (G) consisting of several lobes of cream coloured alveoli embedded in the apical whorls of the digestive gland. Hermaphroditic duct (GD) relatively long and convoluted. Talon pear-shaped with a short stalk. Carrefour not conspicuous. Albumen gland (GG) a mass of creamy-brown acini. Prostate-uterus compacted. Uterus (UT) conspicuously sacculate; prostate (DG) a narrow band of creamy-coloured alveoli appressed to the uterine surface for the entire length. Vas deferens (VD) long and strongly convoluted. Epiphallus (E) longer than penis, muscularised, bound to penial sheath by connective tissue, internally with several rows of longitudinally arranged, sub-rectangular pustules; inserting on penis apically. Epiphallic flagellum (EF) moderately long and arising at epiphallus-vas deferens junction, bound in connective tissue. Penial retractor muscle (PRM) inserting on epiphallus at about one third of its length from penis. Penis (P) cylindrical with a muscularised sheath (PS) for its entire length; internally (Fig. 3B) with a long central, sculptured, longitudinal pilaster (PPM), a short sculptured apical pilaster (PPS) and several narrower, sculptured longitudinal pilasters (PP). Otherwise with low, irregularly shaped, sometimes subcircular (particularly apically) but generally elongate pustules and low, very narrow, longitudinal thickenings basally. Epiphallic pore (EP, Fig. 3C) located laterally on a sculptured vergic papilla (PV). Free oviduct (UV) short, internally with broad transverse thickenings. Spermatheca (S) with an expanded stalk (SS) and clavate head appressed to the prostate-uterus about three quarters distance along its length from the free oviduct. Vagina (V) very short, internally with transversely arranged thickenings. Atrium (Y) very short.

Radula with a tricuspid central tooth (Fig. 4A) with a basal plate which has two prominent lateral support ridges and a well developed anterior flare (Fig. 4B, C); basically bicuspid lateral teeth with greatly reduced endocone located high up on mesocone (Fig 4A); and a very large number of marginal teeth (Fig. 4D, E) that are bicuspid with long sinuate shafts which become denticulate along their outer edge in the outer marginals. Radular formula approximately 130.14.1.14.130. Jaw (Fig. 4F) strongly arcuate without prominent sculpture.

Based on 2 dissected specimens (QMMO20858, MO60128).

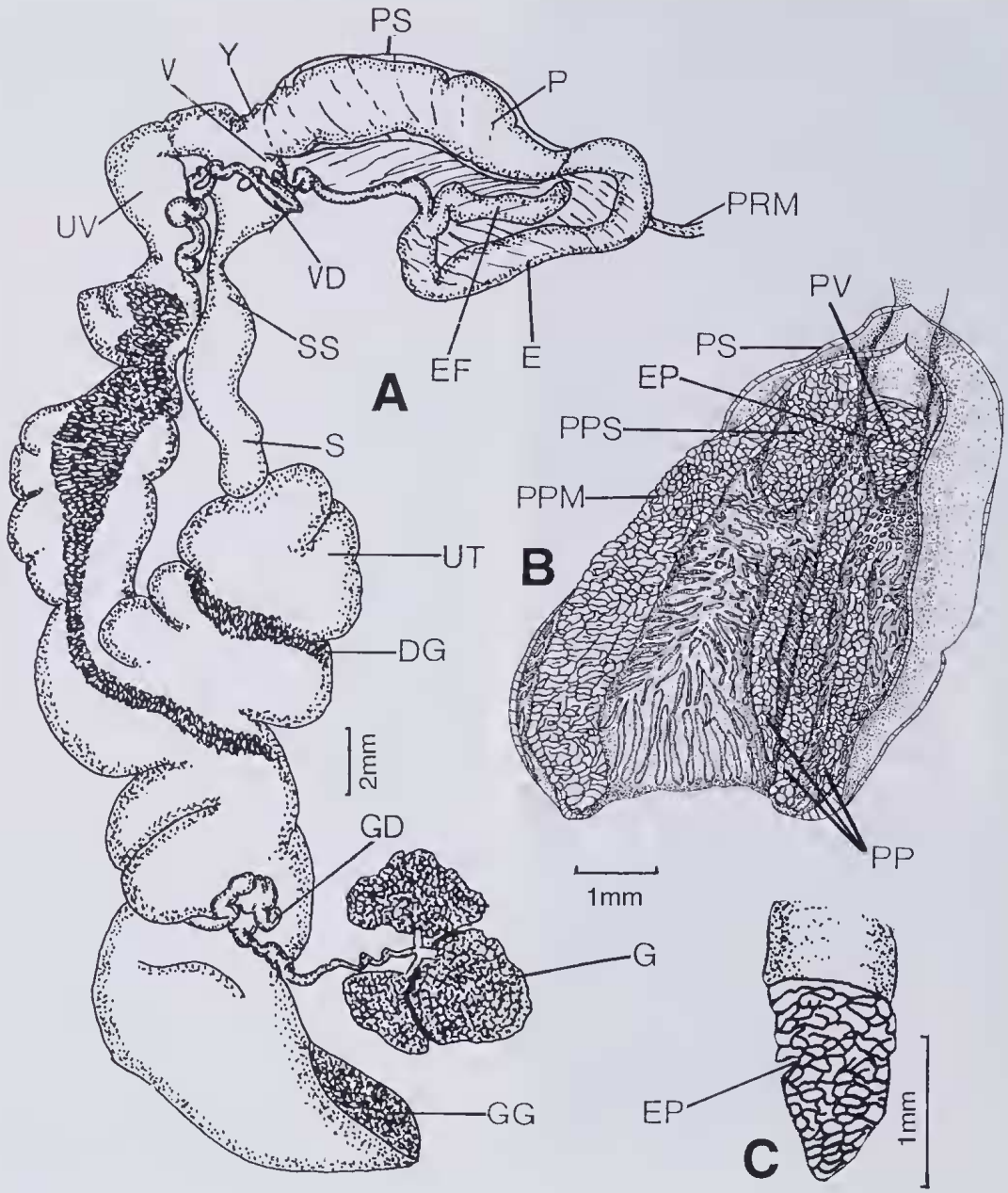

FIG. 3. *Cucullarion parkini* sp. nov., holotype, QMMO60128. A, reproductive system. B, penis interior. C, details of penial verge. Scale lines as marked.

RANGE AND HABITAT. Known only from Tamborine Mtn, SEQ (Fig. 5); in notophyll vine forest.

COMPARISONS. *C. parkini* sp. nov. can be distinguished from the sympatric rainforest-dwelling *Fastosarion aquila* (Cox, 1866) by its shell, animal colour and skin texture. The latter species has a shell which is rounded with complete internal whorls and which has comparatively strong spiral sculpture. The animal of *F. aquila* has roughly textured skin, orange-brown colour, black spots on the shell lappets and mantle lobes,

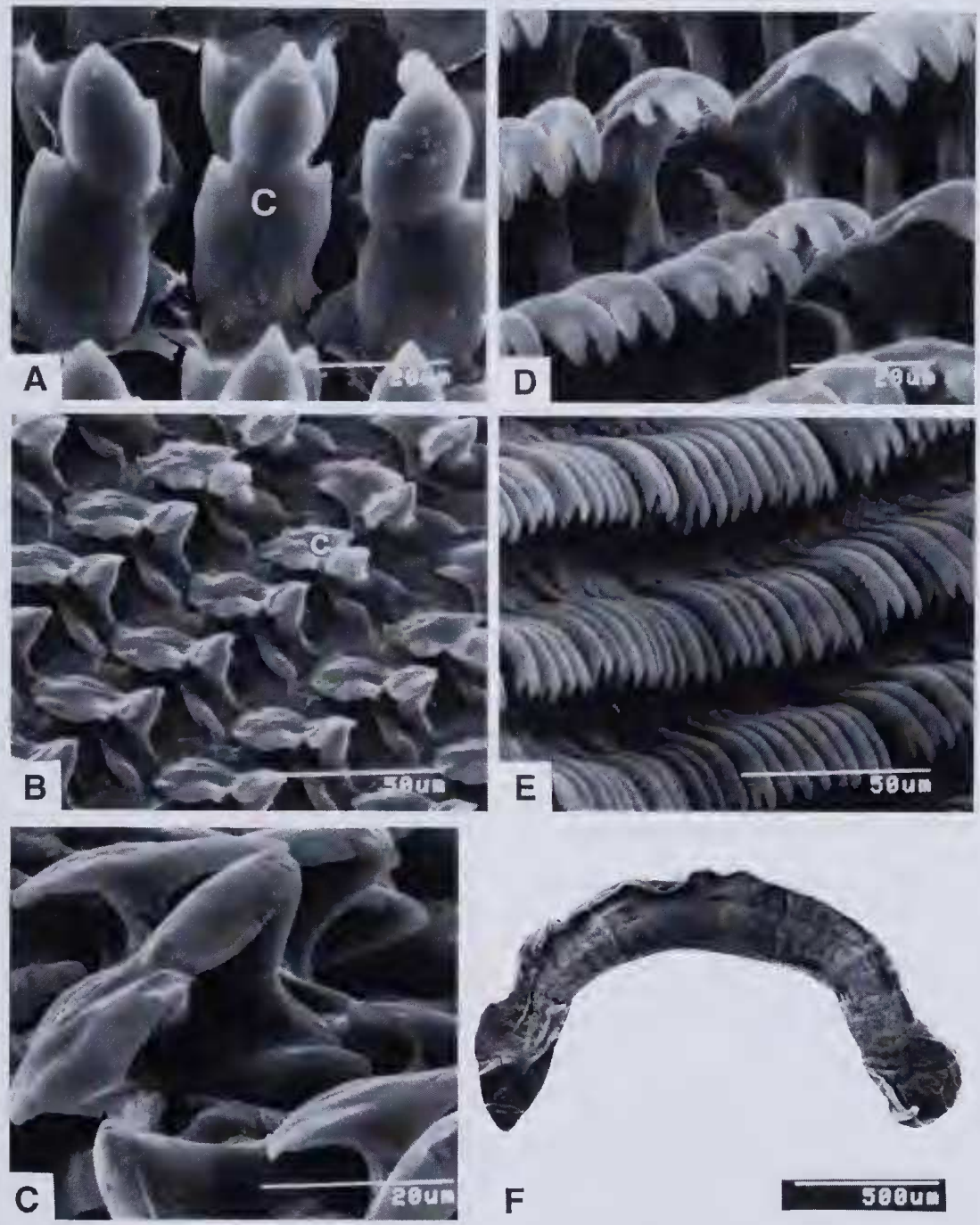

FIG. 4. Radula and jaw of *Cucullarion parkini* sp. nov., paratype, QMMO20858. A, central (marked c) and inner lateral teeth. B, central (marked c) and inner lateral teeth showing basal plate and interrow support. C, close-up of lateral tooth showing basal plate and interrow support mechanism (note cusp wear). D, inner marginal teeth (note freak tricuspid in centre). E, outer marginal teeth. F, jaw. Scale lines as marked.

and orange outer margins on the sole of the foot (whitish in *C. parkini*). *F. virens* (Pfeiffer, 1849) occurs in rainforest on Tamborine Mtn but can also be found in wet sclerophyll forest. The ani-

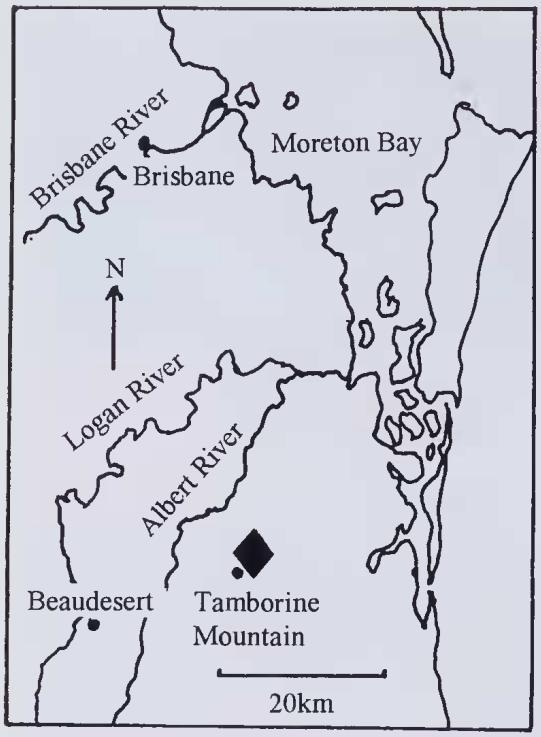

FIG. 5. Type locality of *Cucullarion parkini* sp. nov. (◆).

mal of this species is smooth externally, pinkish-grey in colour with pink to red outer margins on the sole of the foot. The shell of *F. virens* has complete internal whorls and fine spiral sculpture (Stanisic, 1995).

The radular teeth of *C. parkini* do not differ greatly in structure from those of other species of semi-slug examined by the author (Stanisic, 1993a, b). Most variability in the radula of these species appears to occur in the relative numbers of lateral and marginal teeth. In this respect *C. parkini* is most similar to *Eungarion mcdonaldi* Stanisic, 1993 from the rainforests of the highlands W of Mackay, MEQ which also has few laterals and a very large number of marginals. However, as suggested by Stanisic (1993b), these teeth counts may merely reflect similarity in feeding preferences.

REMARKS. *C. parkini* sp. nov. is a relatively rare native land snail. Only a single lot of live individuals has been collected from the trunks of palm trees on Tamborine Mtn even though this locality has been a much-visited collecting spot during the author's 17 year tenure at the QM. Previously only one shell existed in a private collection which was acquired by the Museum in 1989. The live specimens were collected during a thunderstorm when they emerged from among the roots of palm trees.

The sleek form and beige colour of the animal of *C. parkini* is an unusual combination of features among the many species of often large and colourful semi-slugs present in eastern Australia (Stanisic, unpubl.).

DISCUSSION

The reduction in the internal whorls of *C. parkini* is similar to that seen in the MEQ and NEQ species, *Thularion semoni* Stanisic, 1993, *E. mcdonaldi* Stanisic, 1993 and *Parmacochlea fischeri* Smith,1884 (see Hedley, 1893; Stanisic, 1993a, b). Stanisic (1993a) suggested that such species of semi-slug have a more acute sensitivity to environmental moisture levels than those with less reduced shells. However, the relationships of *C. parkini* are not immediately obvious because major anatomical differences between the aforementioned species and *C. parkini* suggest that the similarity in the degree of shell reduction is probably due to convergence among species which have independently become adapted to particularly moist environments. *C. parkini* may be a derivative of a more completely shelled local ancestor in which case the lineage may also include other local extant species such as *F. aquila* and *F. virens*. However, anatomical data (Stanisic, unpubl.) suggest that any relationship between these species and *C. parkini* is also distant.

Alternatively, *C. parkini* might be a remnant of a once more widespread group of colonisers which already had reduced shells and which were adapted to areas of high rainfall. Such conditions could have been present even in much of the lowlands in eastern Australia in the Oligocene and Miocene (Galloway & Kemp, 1981; Kemp, 1981). Subsequent shift in climate to a drier regime restricted these rainforest habitats to upland and montane refugia which were able to maintain high and stable moisture levels either through rainfall or cloud-drip. If the ancestors of *C. parkini* were specialised for this wet environment then they too would have been restricted to a series of upland rainforest fragments. In these circumstances it would be reasonable to expect that any other potential remnants of that group might also now occur in wetter mountain-top habitats.

Evidence from palynological studies suggests that major shifts in the extent of rainforest along the east coast of Australia have taken place in the Pleistocene and in particular since the last inter-

glacial i.e., 120,000 years ago (Hopkins et al., 1996; A.P. Kershaw, 1985; A.P. Kershaw et al., 1991). On a number of occasions during this period rainforest was restricted to small, perennially moist refugia such as mountain tops. Although these conclusions were based on core samples from SE Australia and NE Queensland , it might not be unreasonable to expect that they also have applicability to the rainforests of the Border Ranges. This region includes a number of montane refugia which would have provided suitable stable moisture regimes for the persistence of rainforest. The rainforests of the Darlington Ra. are only small outliers of this massif and it would not be an altogether unexpected discovery if close relatives of *C. parkini* are found in the higher reaches of the MacPherson Ranges where rainforest is even more extensive.

The common name 'Hooded Semi-slug' is proposed for this species.

ACKNOWLEDGEMENTS

I thank Kylie Stumkat for the scanning electron micrographs and the staff of the QM photography section for their assistance with the illustrations.

LITERATURE CITED

GALLOWAY, R.W. & KEMP, E.M. 1981. Late Cainozoic environments in Australia. Pp. 52-80. In Keast, A. (ed.), Ecological biogeography of Australia. (Dr W. Junk: The Hague).

HEDLEY, C. 1893. On *Parmacochlea fischeri* Smith. The Macleay Memorial Volume, Linnaean Society of New South Wales: 201-204.

HOPKINS, M.S., HEAD, J., ASH, J.E., HEWETT, R.K. & GRAHAM, A.W. 1996. Evidence of a Holocene and continuing recent expansion of lowland rainforest in humid, tropical North Queensland. Journal of Biogeography 23: 737-745.

KEMP, E.M. 1981. Tertiary Palaeogeography and the evolution of the Australian climate. Pp. 32-49. In Keast, A. (ed.), Ecological biogeography of Australia. (Dr W. Junk: The Hague).

KERSHAW, A.P. 1985. An extended late Quaternary vegetation record from north-eastern Queensland and its implications fot the seasonal tropics of Australia. Proceedings of the Ecological Society of Australia 13: 179-189.

KERSHAW, A.P., D'COSTA, D.M., McEWEN MASON, J.R.C. & WAGSTAFF, B.E. 1991. Palynological evidence for Quaternary vegetation and environments of mainland southeastern Australia. Quaternary Science Reviews 10: 391-404.

KERSHAW, R.C. 1979. Redescription of *Helicarion cuvieri* from southern Tasmania and *Helicarion freycineti* from New South Wales (Pulmonata: Helicarionidae). Journal of the Malacological Society of Australia 4: 145-156.

1981. Redescription of the genus *Helicarion* and of *Helicarion niger* (Quoy & Gaimard, 1832) from Victoria (Pulmonata: Helicarionidae). Journal of the Malacological Society of Australia 5:17-31.

1983. The identity of *Helicarion freycineti* Ferussac (Mollusc: Pulmonata). Journal of the Malacological Society of Australia 6: 59-61.

MACDONALD, I.S. 1988. Geology. Pp. 9-13. In Guyatt, J. (ed.), A natural history of Tamborine Mountain. (Tamborine Mountain Natural History Association: Beaudesert).

1988. Climate. Pp. 16-18. In Guyatt, J. (ed.), A natural history of Tamborine Mountain. (Tamborine Mountain Natural History Association: Beaudesert).

ROSS, S.I. 1988. European settlers. Pp. 91-95. In Guyatt, J. (ed.), A natural history of Tamborine Mountain. (Tamborine Mountain Natural History Association: Beaudesert).

SCOTT, B. 1995. Redescription of *Fastosarion superba* (Cox, 1871), with descriptions of two new species of *Fastosarion* from northern Queensland (Pulmonata: Helicarionidae). Molluscan Research16: 69-80.

SMITH, B.J. 1992. Non-marine Mollusca. Pp. 1-405. In Houston, W.W.K. (ed.), Zoological Catalogue of Australia. (Australian Government Publishing Service: Canberra).

SOLEM, A. 1966. Some non-marine mollusks from Thailand, with notes on classification of the Helicarionidae. Spolia Zoologica Musei Hauniensis 24: 7-110.

1976. Endodontoid land snails from Pacific Islands. Part I. Family Endodontidae. Fieldiana: Zoology, Special Publication 1-508.

STANISIC, J. 1993a. The identity of *Helicarion semoni* Marten, 1894: a large semi-slug from the Wet Tropics, northeastern Queensland (Pulmonata: Helicarionidae). Memoirs of the Queensland Museum 34: 1-9.

1993b. *Eungarion mcdonaldi* gen. et. sp. nov., a montane semi-slug from mideastern Queensland rainforests (Pulmonata: Helicarionidae). Memoirs of the Queensland Museum 34: 27-34.

1995. Land snails. Pp. 13-22. In Ryan, M. (ed.), Wildlife of Greater Brisbane. (Queensland Museum: Brisbane).

WEBB, L.J. (1988). Overview. Pp. 6-8. In Guyatt, J. (ed.), A natural history of Tamborine Mountain. (Tamborine Mountain Natural History Association: Beaudesert).